

## **Experimental Study of the Effect of Water on the Thermodynamic Properties of Pure Components of Biogas**

Ángel Gómez-Hernández<sup>S</sup>, Roberto Hernández-Gómez, José J. Segovia and María C. Martín  
*Grupo de Termodinámica y Calibración TERMOCAL, Universidad de Valladolid, Valladolid, Spain*

Teresa E. Fernández-Vicente and Dolores del Campo  
*Centro Español de Metrología, Tres Cantos, Madrid, Spain*

César R. Chamorro<sup>C</sup>  
*Grupo de Termodinámica y Calibración TERMOCAL, Universidad de Valladolid, Valladolid, Spain*  
*cescha@eii.uva.es*

As natural gas resources are declining and the European Union depends increasingly on imported natural gas, diversification of the European natural gas supply is underway. The Renewable Energy Directive 2009/28/EC requires that 20 % of the European Union energy consumption should come from renewable sources by 2020. Therefore it is an urgent need to significantly increase the amount of biogas injected into natural gas networks. The diversity of the feed stocks used to produce biogas means that a large number of parameters need to be specified. This work presents the effect of small amounts of water vapor on the thermodynamic properties of pure components of biogas, such as methane and nitrogen. Experimental data on density, speed of sound and the saturation curve for mixtures of methane or nitrogen with small amounts of water, measured by means of a single-sinker densimeter, a spherical resonator and a cylindrical microwave resonator, are presented. Measurements are performed at temperatures between 250 K and 400 K, and pressures up to 20 MPa. Some related practical properties, such as the dew point and the enhancement factor, are estimated. This work is part of the project ENG54, Metrology for Biogas, of the European Metrology Research Programme (EMRP), jointly funded by the EMRP participating countries with EURAMET and the European Union. The research project receives funding from the European Community's Seventh Framework Programme, ERA-NET Plus, under Grant Agreement No. 217257.